Survey Paper on Smart Planter: Simplifying Plant Care with AI Sensors

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Abstract

This paper introduces an intelligent plant care system designed to address the common challenges of indoor gardening, particularly for novice or time-constrained individuals. By integrating IoT-based sensors and artificial intelligence, the system continuously monitors critical environmental parameters such as soil moisture, temperature, and light intensity. Real-time data is processed through machine learning algorithms to predict care requirements and automate interventions, including irrigation adjustments, with minimal user involvement. A mobile application provides intuitive visualization, remote monitoring, and actionable insights, thereby enhancing user experience and plant health management. The study discusses the layered architecture, benefits, limitations, and potential integration with smart home ecosystems. Future directions highlight the growing role of AI in making indoor plant care more precise, efficient, and accessible.

Keywords: IoT, AI Sensors, Smart Plant Care, Machine Learning, Indoor Gardening, Automation

1. Introduction

Indoor plants are increasingly valued for their ability to enhance aesthetics, improve air quality, and promote psychological well-being in modern living spaces [1]. Despite these benefits, maintaining healthy plants remains a challenge for many individuals, particularly beginners or those with limited time. Common issues such as irregular watering, inadequate lighting, and insufficient knowledge about plant-specific needs often result in poor growth or premature plant loss. Traditional plant care relies heavily on personal experience or guesswork, which can lead to inconsistent results and missed opportunities for timely intervention.

Advancements in artificial intelligence (AI) and the Internet of Things (IoT) offer innovative solutions [2], [4], [5] to these challenges by enabling continuous, real-time monitoring of plant health parameters. Sensors can capture essential data—such as soil moisture, ambient temperature, and light intensity [3], [6]—which, when analyzed through machine learning models, provide actionable insights into plant requirements. These systems not only predict plant needs but also automate essential care activities like watering, thereby reducing the dependency on user intervention.

Smart plant care systems therefore represent a significant step toward hassle-free gardening. By combining sensor-driven data collection, predictive analytics, and automated control, they ensure optimal growing conditions while enhancing user convenience. This integration of AI and IoT technologies paves the way for a more sustainable and accessible approach to indoor gardening, making plant care more efficient, consistent, and user-friendly.

2. Methodology

The development of the Smart Plant Care System follows a structured methodology consisting of four main phases: requirement gathering, system architecture design, algorithm development, and flowchart modeling. Each phase ensures that the system is user-centric, efficient, and capable of delivering reliable plant care automation.

1. Requirement Gathering

The requirement analysis focused on identifying the essential needs of plant owners, particularly beginners and busy individuals [4]. The following core requirements were established:

- Environmental Monitoring: Sensors to measure soil moisture, ambient temperature, and light intensity.
- Automated Care: Automatic adjustment of irrigation and environmental conditions based on real-time sensor inputs.
- User Interface: A mobile application for real-time monitoring, system alerts, and manual control.
- Data Analysis: Integration of machine learning algorithms for predictive care and scheduling of plant maintenance.

These requirements ensure that the system simplifies plant management while promoting healthier growth.

2. System Architecture

The architecture of the system is designed in layered form to support scalability and efficiency:

- Physical Layer: IoT sensors (soil moisture, temperature, light) gather real-time data. Actuators, such as irrigation pumps, respond automatically to sensor feedback.
- Data Processing Layer: A microcontroller (e.g., Arduino or Raspberry Pi) collects sensor data, processes it locally, and forwards it for cloud-based analysis.
- Cloud Layer: Provides secure storage and applies machine learning algorithms to predict plant care needs.
- User Interface Layer: A mobile application displays live sensor readings, notifies users of abnormal conditions, and allows manual overrides.
- Decision-Making Layer: A rule-based and AI-driven decision engine determines when to initiate irrigation or alert the user, ensuring timely and accurate plant care.

3. Algorithm

The functioning of the system is governed by the following algorithmic steps:

1. Initialize: Activate system components including sensors, microcontroller, and wireless modules.
2. Collect Data: Continuously measure soil moisture, temperature, and light intensity.
3. Set Thresholds: Define optimal ranges for each environmental parameter.
4. Analyze Data: Compare sensor inputs with threshold values using machine learning models.
5. Predict Needs: Apply time-series forecasting to anticipate irrigation or light adjustments.
6. Automate Actions: Trigger irrigation if soil moisture is below threshold; adjust environment as needed.
7. Notify User: Send alerts and recommendations through the mobile app.
8. Update Dashboard: Display plant status and actions in real time.
9. Repeat Process: Continue monitoring and adjusting until the system is turned off.

4. Flowchart

The flow of operations can be summarized as:

- Start → Collect Sensor Data → Process Data → Analyze with Machine Learning → Predict & Automate Actions → Notify User → Update App → Repeat → End

This cyclical process ensures continuous monitoring and intervention to maintain optimal plant health.

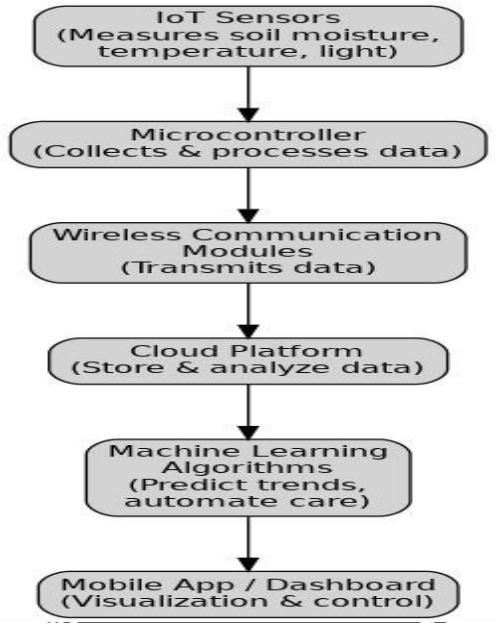

Fig. 1 Flowchart

3. Conclusion

The AI-enabled smart plant care system demonstrates how advanced technologies can significantly improve indoor gardening [2], [5] by reducing reliance on manual observation and guesswork. Through the integration of IoT sensors, cloud computing, and machine learning algorithms, the system continuously monitors vital environmental factors—such as soil moisture, temperature, and light—and ensures plants receive timely and appropriate care. This automation not only improves plant health but also minimizes common issues like overwatering, underexposure to light, and neglect.

A key advantage of the system lies in its ability to provide real-time insights and alerts through a user-friendly mobile interface. By intervening only when necessary, it reduces the need for constant human supervision while still enabling users to remain connected with their plants. This balance of automation and user engagement makes the system highly practical for individuals with limited time or experience.

Overall, the proposed solution contributes to more sustainable and accessible plant care practices. It enhances convenience, supports healthier growth, and fosters a deeper connection between individuals and their living environments. With further advancements in AI and integration into broader smart home

ecosystems, such systems hold the potential to transform plant care into a more efficient, intelligent, and rewarding experience.

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